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(54) **CUTTING HEAD FOR MACHINE TOOL**

SCHNEIDKOPF FÜR WERKZEUGMASCHINE

TETE DE COUPE POUR MACHINE OUTIL

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Description

[0001] The present invention concerns cutting heads intended for boring bars and similar tool holders used in machine tools. These are used for internal turning. A cutting head according to the preamble of claim 1 is known, for example, from WO-A-99/39852.

[0002] Especially, the invention concerns a particularly light cutting head giving an adapter higher natural frequency such that the adapter can be longer than what is common today.

[0003] During internal turning, it easily occur vibrations, blocking, due to the lowest natural frequency being in the same area as the naturally occurring oscillations in the shear forces or cutting forces where the process takes place. It creates poor quality of the machined surfaces, noise and poor accuracy on the work piece. It has been developed technology damping such vibrations, such that it can be machined with tool lengths up to 14 times the diameter of the boring bar.

[0004] Examples of vibration damping systems for boring bars are shown in US Patent No. 5,558,477 where it is used an active negative capacitance shunt circuit with a piezo electric reaction mass actuator. The patent describes a complicated system based on electrical circuits for the damping of the vibration from the boring bar.

[0005] EP-0 342 692 shows a cutting tool, but does not describe how vibrations can be dampend or how the boring bars length can be increased.

[0006] WO 94/04300 shows a tool holder unit where how cooling fluid flows out of the tool holder is specified.

[0007] None of the shown publications solves the problems with vibrations when using long boring bars or rods in a simple way. Accordingly there it is need for an economical and simple way to expand the area for vibration free machining such that longer boring bars can be used.

[0008] This is achieved with the present invention according to claim 1.

[0009] The invention concerns a cutting head that has been optimised in terms of the relationship between weight and strength. Reducing the weight of a cutting head with 50% can increase the natural frequency of the system to such an extent that the length of the machined hole can be increased with a half to one times the diameter of the adapter. The fact that the cutting head has a high dynamic rigidity does hence result in the tool coming further into the work piece without the creation of harmful vibrations.

[0010] The invention provides a cutting head that is designed to be secured in an adapter or a boring bar. The cutting head bears against the adapter in a coupling surface. The coupling surface is designed with means for orientation, such as serrations, guide pins or gussets. The cutting head has a flange part adapted for being secured or fastened to the adapter. The fastening can be provided by screws or bolts screwed through the flange and into the adapter, be magnetic, have a bayonet joint, be clamped with clamps, or in any way secured to the adapter. The adapter and the cutting head can alternatively be designed in one piece.

[0011] The adapter will normally have a circular cross section and the cutting head will have a substantially circular cross section corresponding to the adapter.

[0012] Preferably the cutting head and the adapter are in two parts, and the cutting head and the adapter defines an interface or a coupling surface substantially perpendicular to the longitudinal axis of the adapter. This coupling surface will normally be circular. Secured to the adapter is a cutting unit, preferably with a replaceable cutting insert or turning tool of common type. The cutting unit can for instance include a chip breaker, a replaceable cutting insert, a base screw and a base. The cutting insert can be screwed to the cutting head, or be secured with a clamping device and a clamping screw. Alternatively, the cutting insert can be an integrated part of the cutting head or in any other way be secured to the cutting head.

[0013] The cutting insert is secured to a protrusion being an integrated part of the cutting head.

[0014] The cutting head comprises a substantially circular flange part defined by the coupling surface and a free surface on the opposite side of the flange, turning away from the coupling surface. The coupling surface defines a first plane and the free surface defines a second plane. The first and the second plane defines an angle such that these planes are not parallel. The free surface may have various sections creating new planes that will create angles with the first plane as well.

[0015] A protrusion extends from the free surface or surfaces of the flange. This protrusion carries the previously mentioned cutting unit. The protrusion and the flange is one integrated piece.

[0016] The transition between the flange with those of the inclined surfaces and the protrusion defines one or several concave curves such that it is created a gradual transition between the protrusion and the inclined flange to avoid stress concentrations in the cutting head and to achieve an optimised relationship between strength, rigidity and weight. In a plane parallel to the anchoring plane for the cutting insert, the protrusion creates a ramp. The transition between the flange and the protrusion creates as mentioned, a concave surface and the end or finish of the protrusion creates a convex surface such that these together creates an approximately S-like shape seen perpendicularly on the ramp, from the flange and out towards the cutting insert.

[0017] It can be provided a hole with a nozzle for providing cutting fluid over the surface defined by the securing surface for the cutting insert or the ramp.

[0018] The ramp also has a convex curved transition to the free surface of the flange. The ramp provides a space for the chips created in the cutting process.

[0019] This implies that the flange may have two different inclined surfaces turning away from the coupling

surface.

[0020] In combination this construction results in an optimum relationship between weight, rigidity and strength, with a good distribution of the stresses in the cutting head and a good ability to transfer heat.
In this way it will be possible to design a cutting head according to the invention with a weight that is approximately 50% of the weight for similar cutting heads according to the known art. Accordingly the natural frequency of the cutting head and the adapter increases and gives an increase of the maximum cantilever length. The increase will be in an order of magnitude of about one half to one time the boring bar diameter.

Short description of the drawings.

[0021]

Fig. 1 shows a side elevation of a cutting head according to one embodiment of the invention;
Fig. 2 shows a front elevation of the invention as shown on fig. 1;
Fig. 3 shows a perspective view of the cutting head shown on fig. 1 and 2;
Fig. 4 shows a view seen perpendicular on the cutting head as shown on fig. 1, 2 and 3;
Fig. 5 shows a cutting head according to the invention secured to an adapter; and
Fig. 6 shows a perspective exploded view of a cutting head according to the invention and an adapter.

[0022] The invention will now be further described by way of the following example.

[0023] Fig. 1 shows a side elevation of a cutting head with a coupling surface 4 with serrations 11, a protrusion 8 with an upper surface or ramp 12, where the cutting head furthermore comprises a cutting insert 5, and the securing surface for the cutting insert. Furthermore it is shown an, in relation to the coupling surface, inclined free surface 1 B going into a concave curve R3 to the ramp 12 on the protrusion 8. The protrusion 8 includes elements for securing (not shown) the cutting insert 5. Securing cutting inserts is well known in the subject area and will not be further described here.

[0024] Fig. 2 shows a front elevation of the adapter shown on fig. 1, where holes for securing the cutting head to the adapter with screws and bolts are shown. The figure also shows two inclined surfaces A1, 1B and the cutting insert 5 on the protrusion 8.

[0025] Fig. 3 shows that the transition between the flange and the ramp 12 is designed with a radius R3. The figure shows furthermore a cutting insert holder with a cutting insert 5, a hole with a nozzle for bringing forward cutting fluid 7, a transition between the flange and the protrusion 8 comprising an S-shape 2 of a concave surface with a radius R2 and a convex surface, an inclined surface 1A turning away from the coupling surface 4, whose plane creates an angle V1 with the plane of the coupling surface 4 and holes 6 for securing the cutting head to the adapter.

[0026] Fig. 4 shows a view perpendicular to the figure shown on fig. 1 with serrations 11 in the coupling surface 4 towards the adapter, the inclined surface 1A, the S-shaped transition 2 with the concave surface with a radius R2 and the convex surface between the inclined surfaces of the flange with an angle V1 and the protrusion 8, the hole for bringing forward cutting fluid 7, the ramp 12 and the cutting insert 5.

[0027] Fig. 5 shows the cutting head 13 as defined on fig.1, 2, 3 and 4, secured to a boring bar 9 by means if bolts 10.

[0028] Fig. 6 shows the cutting head 13, the bolts 10 and the adapter 9 as shown on fig. 5 in an exploded view where the serrations 11 on the adapter are clearly shown.

[0029] This construction has given a weight reduction of 50% and this has increased the natural frequency of the system in a way such that cantilever length can be increased with a half to one time the diameter of the adapter.

Claims

1. A cutting head (13) for being secured to an adapter (9), in a machine tool for chip removing machining, where the cutting head (13) comprises a flange with a first side creating a coupling surface (4) adapted for being secured to the adapter (9), and an on the opposite side of the flange situated, other side creating at least one surface (1A) with an outwardly extending protrusion (8), with securing means adapted for the securing of a cutting insert (5) with at least one cutting edge,

the at the least one surface (1A) defining a plane creating an inclined angle (V1) in relation to a plane parallel to the coupling surface (4), whereby the cross-sectional thickness of the flange increases from a first lateral side to an oppositely situated other lateral side; **characterized in that**

a concave surface with a radius (R2) between the at least one surface (1A) of the flange and the protrusion (8) creates a smooth transition between the flange and the protrusion (8) and the protrusion (8) extends from that part of the flange having the increased thickness; and

the protrusion (8) and the flange with the at least one surface (1A) with an inclined angle (V1) in relation to the plane parallel with the coupling surface (4), is one integrated piece whereby the weight of the cutting head (13) is reduced as compared to the strength of the cutting head (13), and the natural frequency of the cutting head (13) is increased when this is secured to the adapter (9).

2. A cutting head according to claim 1,

wherein the protrusion (8) is rounded towards the cutting insert (5), such that it is created an S-shape (2) between the flange and an end surface of the protrusion (8) whereby a space for good chip departure is created.

3. A cutting head according to claim 1, wherein the other side of the flange comprises two surfaces (1A, 1B) defining two inclined planes in relation to the plane of the coupling surface (4).

4. Cutting head according to claim 1, wherein the transition between the two inclined surfaces (1A, 1B) of the flange and the protrusion (8) defines smooth transitions with defined radiuses (R2, R3) to reduce stress concentrations in the cutting head.

5. Cutting head according to claim 1, wherein the cutting head comprises a hole with a nozzle (7) for bringing forward a cutting fluid.

Patentansprüche

1. Schneidkopf (13) zum Befestigen an einer Zwischenstange (9) in einer Werkzeugmaschine für spanabhebende Bearbeitung, wobei der Schneidkopf (13) einen Flansch mit einer ersten Seite, die eine Verbindungsfläche (4) erzeugt, die zum Befestigen an der Zwischenstange (9) eingerichtet ist, und an der gegenüberliegenden Seite des Flansches liegend einer anderen Seite umfasst, die wenigstens eine Fläche (1A) mit einem sich nach außen erstreckenden Vorsprung (8) mit Befestigungseinrichtungen erzeugt, die für die Befestigung eines Schneideinsatzes (5) mit wenigstens einer Schneidkante eingerichtet sind,
die wenigstens eine Fläche (1A) eine Ebene definiert, die einen Neigungswinkel (V1) in Bezug auf eine Ebene parallel zu der Verbindungsfläche (4) erzeugt, so dass sich die Querschnittsdicke des Flansches von einer ersten Querseite zu einer gegenüberliegenden anderen Querseite vergrößert, **dadurch gekennzeichnet, dass**:

eine konkave Fläche mit einem Radius (R2) zwischen der wenigstens einen Fläche (1A) des Flansches und dem Vorsprung (8) einen allmählichen Übergang zwischen dem Flansch und dem Vorsprung (8) erzeugt und der Vorsprung (8) sich von dem Teil des Flansches mit der größeren Dicke erstreckt; und

der Vorsprung (8) sowie der Flansch mit der wenigstens einen Fläche (1A) mit einem Neigungswinkel (V1) in Bezug auf die Ebene parallel zu der Verbindungsfläche (4) aus einem Stück bestehen, so dass das Gewicht des Schneidkopfes (13) verglichen mit der Festigkeit des Schneidkopfes (13) verringert wird und die Eigenfrequenz des Schneidkopfes (13) erhöht wird, wenn dieser an der Zwischenstange (9) befestigt ist.

2. Schneidkopf nach Anspruch 1, wobei der Vorsprung (8) auf den Schneideinsatz (5) zu abgerundet ist, so dass eine S-Form (2) zwischen dem Flansch und einer Endfläche des Vorsprungs (8) erzeugt wird und ein Raum für guten Spanabfluss erzeugt wird.

3. Schneidkopf nach Anspruch 1, wobei die andere Seite des Flansches zwei Flächen (1A, 1 B) umfasst, die zwei geneigte Ebenen in Bezug auf die Ebene der Verbindungsfläche (4) definieren.

4. Schneidkopf nach Anspruch 1, wobei der Übergang zwischen den zwei geneigten Flächen (1A, 1B) des Flansches und dem Vorsprung (8) allmähliche Übergänge mit definierten Radien (R2, R3) definiert, um Spannungskonzentrationen in dem Schneidkopf zu verringern.

5. Schneidkopf nach Anspruch 1, wobei der Schneidkopf ein Loch mit einer Düse (7) zum Zubringen eines Schneidfluids umfasst.

Revendications

1. Tête de coupe (13) pour fixation sur un adaptateur (9) dans une machine-outil pour l'usinage par enlèvement de copeaux, la tête de coupe (13) comprenant une bride avec un premier côté créant une surface de couplage (4) agencé pour être fixée sur l'adaptateur (9), et un autre côté situé sur le côté opposé de la bride, autre côté créant au moins une surface (1A) avec une saillie (8) s'étendant vers l'extérieur, avec des moyens de fixation adaptés pour la fixation d'un insert de coupe (5) avec au moins un bord coupant,
la au moins une surface (1A) définissant un plan créant un angle incliné (V1) par rapport à un plan parallèle à la surface de couplage (4) , tandis que l'épaisseur en section transversale de la bride augmente à partir d'un premier côté latéral vers un autre côté latéral situé en regard ;
caractérisée en ce qu'une surface concave ayant un rayon (R2) entre la au moins une surface (1A) de la bride et la saillie (8) crée une transition lisse entre la bride et la saillie (8) et la saillie (8) s'étend à partir de cette partie de la bride ayant l'épaisseur augmentée ; et
la saillie (8) et la bride avec la au moins une surface (1A) avec un angle incliné (V1) par rapport

au plan parallèle à la surface de couplage (4) , est une pièce solidaire de sorte que le poids de la tête de coupe est réduit par rapport à la résistance de la tête de coupe (13), et la fréquence naturelle de la tête de coupe (13) est augmentée lorsqu'elle est fixée sur l'adaptateur (9).

2. Tête de coupe selon la revendication 1, dans laquelle la saillie (8) est arrondie en direction de l'insert de coupe (5), de telle sorte qu'il est créé une forme en S entre la bride et une surface d'extrémité de la saillie (6) de sorte qu'il est créé un espace pour la bonne évacuation des copeaux.

3. Tête de coupe selon la revendication 1, dans laquelle l'autre côté de la bride comprend deux surfaces (1A,1B) définissant deux plans inclinés par rapport au plan de la surface d'accouplement (4).

4. Tête de coupe selon la revendication 1, dans laquelle la transition entre les deux surfaces inclinées (1A,1B) de la bride et la saillie (8) définit des transitions libres avec des rayons définis (R2,R3) pour réduire les concentrations de contraintes dans la tête de coupe.

5. Tête de coupe selon la revendication 1, dans laquelle la tête de coupe comprend un trou avec une tuyère (7) pour délivrer un fluide de coupe.

Fig. 1

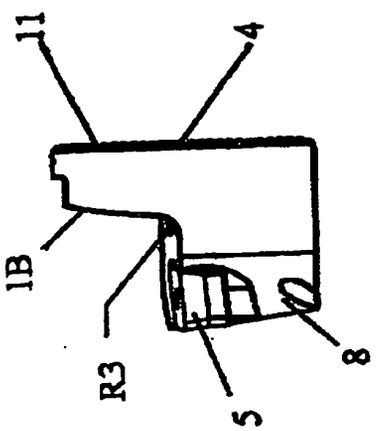


Fig. 2

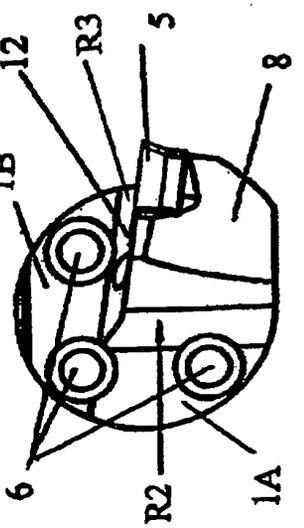


Fig. 4

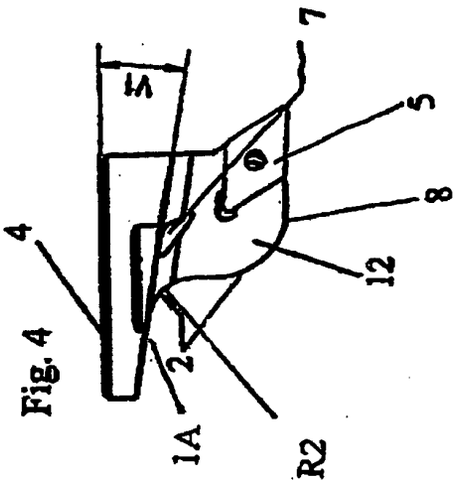
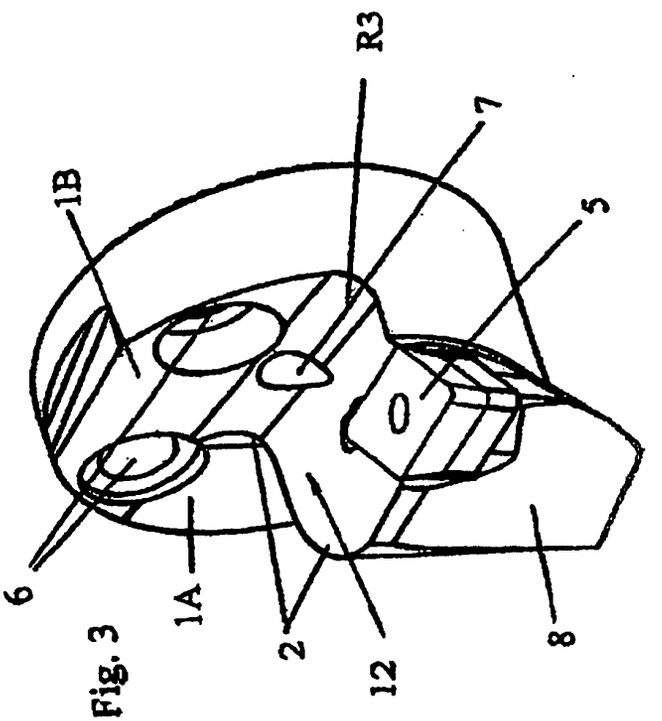


Fig. 3



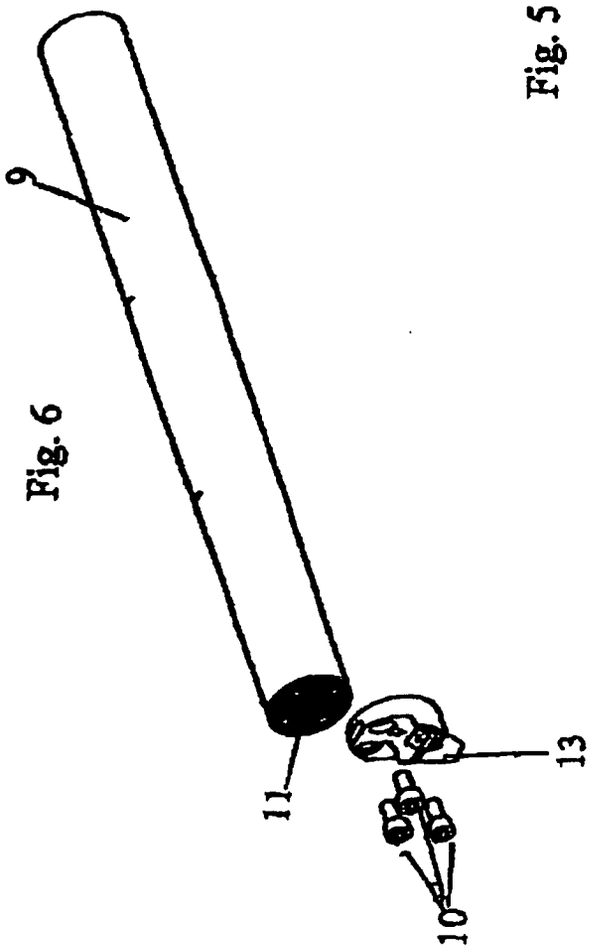


Fig. 6

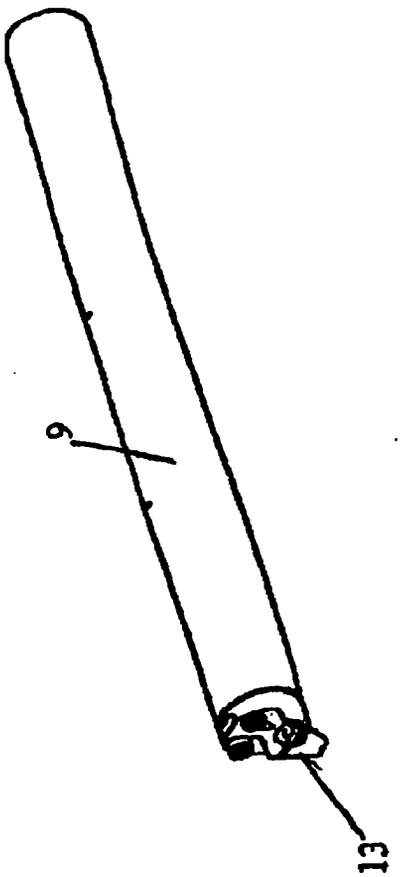


Fig. 5